

Pasteurization

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Pasteurization is the process of heating food for the purpose of killing harmful organisms such as bacteria, viruses, protozoa, molds, and yeasts. The process was named after its inventor, French scientist Louis Pasteur. The first pasteurization test was completed by Pasteur and Claude Bernard on April 20, 1862.

Unlike sterilization, pasteurization is not intended to kill all microorganisms in the food. Compare with appertization invented by Nicolas Francois Appert. Instead, pasteurization aims to achieve a "log reduction" in the number of viable organisms, reducing their number so they are unlikely to cause disease (assuming the pasteurized product is refrigerated and consumed before its expiration date). Commercial scale sterilization of food is not common, because it adversely affects the taste and quality of the product.

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Milk pasteurization

Pasteurization is typically associated with milk, first suggested by Franz von Soxhlet in 1886. There are two widely used methods to pasteurize milk: high temperature/short time (HTST), and ultra-high temperature (UHT). HTST is by far the most common method. Milk simply labelled "pasteurized" is usually treated with the HTST method, whereas milk labelled "ultra-pasteurized" must be treated with the UHT method. HTST involves holding the milk at a temperature of 161.5 degrees Fahrenheit (or 72 degrees Celsius) for at least 15 seconds. UHT involves holding the milk at a temperature of 280 °F or 138 °C for at least two seconds.

Pasteurization methods are usually standardized and controlled by national food safety agencies (such as the USDA in the United States and the Food Standards Agency in the United Kingdom). These agencies require milk to be HTST pasteurized in order to qualify for the "pasteurized" label. There are different standards for different dairy products, depending on the fat content and the intended usage. For example, the pasteurization standards for cream differ from the standards for fluid milk, and the standards for pasteurizing cheese are designed to preserve the phosphatase enzyme, which aids in curing the cheese.

The HTST pasteurization standard was designed to achieve a 5-log reduction (0.00001 times the original) in the number of viable microorganisms in milk. This is considered adequate for destroying almost all yeasts, mold, and common spoilage bacteria and also to ensure adequate destruction of common pathogenic heat-resistant organisms (including particularly *Mycobacterium tuberculosis*, which causes tuberculosis and *Coxiella burnetii*, which causes Q fever). HTST pasteurization processes must be designed so that the milk is heated evenly, and no part of the milk is subject to a shorter time or a lower temperature.

HTST pasteurized milk typically has a refrigerated shelf life of two to three weeks, whereas ultra pasteurized milk can last much longer when refrigerated, sometimes two to three months. When UHT pasteurization is combined with sterile handling and container technology, it can even be stored unrefrigerated for long periods of time.

Alternative pasteurization standards and raw milk

In addition to the standard HTST and UHT pasteurization standards, there are other lesser-known pasteurization techniques. The first technique, called "batch pasteurization", involves heating large batches of milk to a lower temperature, typically 155 °F (68 °C). The other technique is called higher-heat/shorter time (HHST), and it lies somewhere between HTST and UHT in terms of time and temperature.

The batch pasteurization step, which is cheap at a large scale, is often performed prior to standard pasteurization. Batch pasteurized milk is often called "raw milk" or, confusingly, "unpasteurized milk". It cannot be called "pasteurized", even though a significant number of pathogens are destroyed during the process.

In recent years, there has been some consumer interest in raw milk products, due to perceived health benefits. Advocates of raw milk maintain, correctly, that vitamins and nutrients survive much better in milk that has not been pasteurized. They also maintain that organic raw milk (most retail raw milk is also organic) is less likely to contain harmful pathogens due to better husbandry in organic dairy herds. This may be true, but it has not been proven.

However, doctors (and even most raw milk advocates) acknowledge that certain people (e.g. pregnant or breast-feeding mothers, those undergoing immunosuppression treatment for cancer, organ transplant or autoimmune diseases, and those who are immunocompromised due to diseases like AIDS) should not risk consumption of raw milk.

In fact, some doctors suggest that babies and breast-feeding mothers avoid all but UHT pasteurized dairy products.

In Africa, it is common to boil milk whenever it is harvested. This intense heating greatly changes the flavor of milk, which the people in Africa are accustomed to.

Are current standards adequate?

Milk pasteurization standards have been subject to increasing scrutiny in recent years, due to the discovery of pathogens that are both widespread and heat resistant (able to survive pasteurization in significant numbers). Researchers have developed more sensitive diagnostics, such as real-time PCR and improved culture methods, that have enabled them to identify pathogens in pasteurized milk.

Note: The following paragraphs in this section discuss controversial, ongoing research.

One bacterium in particular, the organism *Mycobacterium avium* subspecies *paratuberculosis* (MAP), which causes Johne's disease in cattle and is suspected of causing at least some Crohn's disease in humans, has been found to survive pasteurization in retail milk in the U.S., the U.K., Greece, and the Czech Republic. The food safety authorities in the U.K. have decided to re-evaluate pasteurization standards in light of the MAP results and other evidence of harmful, pasteurization-resistant pathogens.

The USDA (which is responsible for setting pasteurization standards in the U.S.) has not re-evaluated their position on pasteurization adequacy. They do not dispute the studies, which are at this point accepted by the scientific community, but maintain that the presence of MAP in retail pasteurized milk must be due to post-pasteurization contamination. However, some researchers within the FDA, which is responsible for food safety in the U.S., have begun pushing for a re-evaluation of these results. There is a small but growing body of criticism directed at these agencies by Crohn's disease sufferers, scientists, and doctors. Some have suggested that the U.S. dairy industry has been successful in suppressing the agencies' response to a potential health crisis, for fear of consumer panic which would lead to a decrease in milk consumption. It is worth noting that while MAP has not been definitely proven to be harmful in humans, all other mycobacteria are pathogenic, and it has been definitively shown to cause disease in cattle and other ruminants.

A newer method called flash pasteurization involves shorter exposure to higher temperatures, and is claimed to be better for preserving color and taste in some products.

The term cold pasteurization is used sometimes for the use of ionizing radiation (see Food irradiation) or other means (e.g. chemical) to kill bacteria in food. Food irradiation is also sometimes called "electronic pasteurization".

Pasteurized products

Products that can be pasteurized :

- milk
- wine
- beer
- fruit juice
- cider
- honey
- eggs
- sports drinks
- canned food

See also: dairy products, Unpasteurized milk.

References

- Rosenau, M.J., **The Milk Question**, Houghton Mifflin Company, Boston, 1913.

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